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Understanding forest transition in the Philippines: main farm-level factors influencing smallholder's capacity and intention to plant native timber trees

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Abstract The 'when, where and how' of decisions by smallholder upland farmers to plant trees as part of their use of natural, human and capital resources needs to be understood if policy support is to result in actual recovery of tree cover as part of a 'forest transition' trajectory. In large parts of the Philippines the turning point may be close. Data on resource access and tree planting decisions were gathered from a household survey, with a total of 148 respondents in four rural communities in Leyte Province in Central Philippines. Data were analysed using logistic regression analysis. Household-level results reveal that the outcomes of the decision-making processes primarily depend on the availability of land and access to remaining forest resources rather than socio-cultural or economic factors. The total area of land and number of parcels managed by the household plus security of land tenure through ownership was found to have a statistically significant effect on farmers' decision to plant native timber trees. Access to surrounding natural forest is negatively associated with farmer tree planting.

Keywords Agroforestation · Upland farmers · Household survey · Land management · Natural forest

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Introduction

According to the FAO Global Forest Resources Assessment 2005 (FAO 2006) the net loss of forest area in Asia that persisted for many decades has now been halted. From 2000 to 2005, there was an annual net gain averaging just over 1 M ha, to which China, India and Vietnam were major contributors. Although such transition has previously occurred in Europe and North America (Grainger1995), Asia is the first continent to display a transition from net deforestation to net reforestation since systematic collation of data of global forest resources began in the 20th century (Mather 2006). During the same period Indonesia lost 2% of its forest area, the second greatest annual net loss in the world, Cambodia lost 2%, Sri Lanka 1.5% and Myanmar 1.4% (FAO 2006).

For the first time the Philippines may be experiencing the beginning of a national-level forest transition. Although the Global Forest Resources Assessment 2005 (FAO 2006) reported that the country experienced an annual deforestation rate of 157,000 ha per year (−2.1%) during 2000–2005, in a recent review of forest rehabilitation efforts Pulhin et al. (2007) observed that 'in 2003, the National Mapping and Resource Information Authority (NAMRIA) and the Forest Management Bureau (FMB) generated a set of land/forest cover statistics using LANDSAT ETM images from 2002 and 2003 (FBM–FAO 2003). The analysis used harmonized land/forest cover terms and definitions in accordance with international standards (FBM–FAO 2003). Results show that the total forest cover in 2003 was about 7.2 million ha or 24 percent of the country's land area. The new figure is 11 percent higher than the 1988 forest cover of 6.5 million ha.'

Forest expansion take three main forms: (a) the establishment of plantations through large-scale afforestation, as in China, India and Vietnam (FAO 2006); (b) natural regeneration on abandoned agricultural land, which is common in some European countries; and (c) agroforestation, a reforestation approach consisting of land rehabilitation through the establishment of smallholder timber tree-based systems (Roshetko et al. 2007). In the Philippines, the increase in forest cover has been attributed to, in addition to the commercial logging ban, accelerated public and private reforestation efforts, including agroforestation (Bertomeu et al. 2008).

Agroforestry is based on the overall assumption that the integration of trees on farms and in the agricultural landscape diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (Roshetko et al. 2007). However, in many agroforestry projects, adoption rates are low, and where the adoption is successful, the farmers often have to modify and adapt the proposed system to one that suits their requirements. Current et al. (1995) concluded that 'poorer farmers may find agroforestry profitable, but their rate and scale or adoption is often constrained by limited land, labour, and capital resources and their need to ensure food security and reduce risks'.

Farmer decisions to adopt agroforestry are complex in nature and require knowledge (human capital) of the likely consequences (tree-crop competition), supportive village-level institutions (social capital), availability of suitable land and in situ tree germplasm (natural capital), and opportunities to invest time and money (financial capital) (van Noordwijk et al. 2001).

The general open access condition of unoccupied forest land is recognized as a key condition underlying frontier agricultural expansion in many developing tropical countries (Pearce et al. 1990; Mahar and Shceneider 1994; Southgate 1994). According to Barbier (1997), there are two main aspects that explain the consequences of open access to land. First, there are households that forego investments in sustainable farming systems on the land that they initially convert and occupy on the frontier, instead choosing to abandon this land as yields decline and to migrate to new land further in the forest frontier. Second, many households migrate to the frontier because rural employment is increasingly scarce. Both problems involve essentially related processes, which can be referred to collectively as the incentives for rural households to abandon existing agricultural land in favour of converting and occupying new land on the forest frontier.

The economic principle of land use, following the economic geography concepts of von Thunen in the middle of the 19th century, takes as its starting point that land is allocated to the use with the highest land economic rent (Angelsen 2007). The rent of alternative land uses is determined by a number of factors, including crop prices, input costs, available technologies, agro-ecological conditions, and cost of control against pests and human intruders.

The identification of potential tree planters among upland farmers requires the consideration of factors thought to influence their behaviour and the relationships among them (Emtage 2004). Unclear property rights including insecure land tenure have been often identified as having major influence on the expansion of sustainable land-use systems, hence security of land tenure has often been considered a requirement for tree planting (e.g. Godoy 1992). However, use rights rather than land title may suffice (Dewees 1992). Farm size is another important land-related factor influencing tree growing. In the context of subsistence farming, one may expect a large portion of smaller farms planted to staple crops whereas farmers with larger landholdings may be able to devote some land to tree planting without the risk of food scarcity.

Tree-growing decisions are also affected by farm biophysical characteristics and other factors related to land productivity. Expansion of tree growing has been observed in response to declining soil productivity as a result of erosion and fertility depletion (Santos and van Noordwijk 2009). On the other hand, increasing the productivity of staple crops has helped to reduce pressure on the land for subsistence food production and thus to increase the area occupied by tree crops. The location of the farm in relation to the homestead and the road network are also factors that may influence tree planting on a particular farm parcel because ease of access is a requirement for timber harvesting, loading and transport (Garrity and Mercado 1994).

Besides farmers' resources, several studies have emphasized the influence on tree planting of individuals' personal characteristics, including gender, farmer's age—older farmers are more likely to plant trees because of low labour requirements (Dewees 1992)—educational level (Sunderlin 1997) and personal characteristics. The latter include progressiveness (Mahapatra and Mitchell 2001), enterprising attitude and collective co-operation. Relatively high wealth status has been found to increase the likelihood of adopting agroforestry and to be a reliable predictor of farmer participation in social forestry (Hyman 1993). Farmers may expand the area

occupied by trees if cash is available to them, either in the form of credit or from off-farm sources (e.g. remittances). Moreover, when family labour is engaged in off-farm employment, farmers are more likely to invest in tree planting as a low-labour land-use strategy (Bertomeu 2004).

According to Van Noordwijk et al. (2008) three possibilities are open to the government to enhance the forest transition that might be happening in the Philippines: (1) allocating substantial areas of state-controlled land to 'concessionaires' for development of a tree plantation industry, with benefit sharing between the concessionaire and the state; (2) stimulating target tree planting activities in the context of a 'national reforestation' program; and (3) removal of constraints to spontaneous smallholder adoption of native timber-based agroforestry systems as part of their multifunctional landscapes. The first two options have been tried with limited success. There is considerable though untested scope for the third option, as alternative specific 'agroforestry policies' or public incentive schemes created to increase the use of native trees in the landscape and obtain higher terrestrial carbon stocks. Therefore the primary objective of this study is to determine main factors influencing smallholder farmers to engage in an *agroforestation* phase, as an aspect of the forest transition process in the Philippines. The next section provides an overview of the study site and an explanation of the variables considered in the household decision model. Next, the results from the social model explaining the main factors influencing farmers' intention to plant native timber trees are reported. The paper concludes with a discussion on the implications of these factors for reforestation and agroforestation programs.

Study site and research method

This study is part of a broader assessment of the use of native timber trees in upland farming, which included an analysis of farmer management practices, aspects of tree site-species matching and agronomy of agroforestry systems (Santos 2007). Leyte province was selected as the study site because it is representative of upland environments that are intensively cultivated and vastly degraded, and where farmers have started to plant native timber trees as a strategy for livelihoods as well as land rehabilitation (Santos et al. 2010). The communities were selected based on two main variables: the existence of remaining open access natural forest (with versus without natural forest); and the type of soil (productive versus degraded) (Table 1).

Table 1 Study sites selected for the household survey in Leyte Province (Central Phippines)

Selection criterion	Location in Leyte municipality	Community
Degraded soil-with forest	Hinunangan	Calag-itan
Degraded soil-without forest	Tabango	Manlawaan
Productive soil-with forest	Inopacan	Cabulisan
Productive soil-without forest	Tomas Oppus	Mapgap

This information was gathered using existing maps of the study area from the GIS laboratory of Leyte State University.

A household survey of a total of 148 respondents was conducted in four rural communities of Leyte Province in 2006. The selection of study sites was based on two main variables, namely existence of remaining open access to natural forest (with versus without natural forest) and type of soil (productive versus degraded) (Table 1). Respondents were selected randomly from each community based on their willingness to be part of the survey. Household information was consolidated into the Household and Tree database in Leyte province.

Three native timber tree species were commonly found on farmers' fields as a component of agroforestry systems: *Shorea contorta* V., *Pterocarpus indicus* J. and *Vitex parviflora.* Additionally, four planting niches were found across the agricultural landscape, in or around annual cropping land, on perennial cropping land, on grassland and in home gardens. Identified farmers′ tree planting designs include boundary, block, hedgerow-intercropping and scattered. Trees found on farmers' fields were planted in association with other perennial crops (especially coconuts) and in open grassland areas commonly perceived as fallow land; growing trees intercropped with annual food crops was practiced by few farmers and always in low densities.

The quantitative household decision model

The analysis aimed at building a model without a large number of variables but with an acceptable prediction rate (low residual variance). The process of model building began by structuring the information collected from the household survey into four

Table 2 Topics covered and variable description for each level of information of the model

Information level	Topics covered	Description of variable
Site characteristics	Soil characteristics	Productive or degraded
	Access to forest	With or without open access to forest
	Accessibility	Distance to nearest market
Demographic and cultural aspects	Number of household members	Including working and dependent
	Age	Of household head
	Education level	Of household head
	Migrant	Province or region level
	Tree experience	Years in tree farming
Landholding and labour resources	Total area manage	Area owned and tenanted
	Number of parcels	With different land-use systems
	Area owned	Excluding tenanted and rented
	Working household members	On-farm plus off-farm members
	On farm working members	Excluding off-farm members
Economic factors	Total household income	On-farm and off-farm resources
	On-farm income	Agricultural and tree products
	Land productivity	Income per unit of land

levels: (i) site characteristics; (ii) demographic and cultural aspects; (iii) landholding and labour resources, and (iv) economic factors. Specific topics covered and variables selected in each level of information are described in Table 2.

The response variable

The first step of the model building was defining the response variable, which is 'who plants native timber trees?' After field inventory, surveyed farmers were classified as adopters (planters) and non-adopters (non-planters) on the basis of who had planted native timber trees on their land before data collection.

One clear limitation of the study is that 64 (71%) of the non-adopters and all of the adopters of timber trees had also applied other 'specific' tree planting options such as fruit trees or management of natural regenerated tree stands. Because farmers can apply these and other 'specific' tree planting enterprises, within the same set of household and farm conditions, farmers can meet their goals with similar success (e.g. labour-constrained farmers may make a more productive use of fallowed land by planting timber or fruit trees). Consequently, there has probably been a confounding effect introduced in the model by the large number of farmers classified as 'non-adopters' (of native timber trees) that are actually tree growers.

Independent variables

The process of assessing a 'reasonable' set of independent variables that can explain the response variable was based on the results of the exploratory data analysis. The analysis consisted of 'forward selection' of variables to assess the effects of new

Table 3 Final set of independent variables used in the model to explain the response variable 'Plant timber tree'

Variable	Variable type	Description/unit	Hypothesis effect
Soil	Categorical	0 or 1 (0 degraded, 1 productive)	Negative
Forest	Categorical	0 or 1 (0 No forest, 1 Forest)	Negative
Accessibility	Continuous	Distance to nearest market (km)	Negative
Migration	Categorical	0 or 1 (0 No migrated, 1 Migrated)	Negative
Education	Categorical	0 or 1 (0 No education, 1 Education)	Positive
Age	Continuous	Respondent age (Years)	Negative
Tree experience	Continuous	Experience in tree-farming (Years)	Positive
Total area	Continuous	Total number of hectares	Positive
Parcels size	Continuous	Total area/Number of parcels	Negative
Area owned	Continuous	Area owned/Total area	Positive
Work intensity	Continuous	Working HH member/Total area	Negative
Labour	Continuous	Working HH member/HH members	Negative
Income	Continuous	Total HH income/Working HH members	Negative
Farm income	Continuous	Farm Income/Total HH income	Negative
Productivity	Continuous	Farm Income/Total area	Negative

variables and their interactions, and 'backward elimination' to delete unimportant variables and to determine whether effects were masked by possible correlations introduced by other variables. The contribution to the model of each of the independent variables introduced was assessed by chi-squared test (Table 3).

Because the response variable is binary categorical (0 or 1, representing plant or not plant native timber trees) a model was used that handles continuous and categorical variables. As a result from the iterative process of variable selection, a final set of 15 independent variables was chosen which reflected hypotheses of the strongest influence on farmers′ decisions to plant timber trees. For each independent variable the hypothesized effect on the response variable (0 for non-planters and 1 for tree planters) is indicated in Table 3. For example, the variable 'Age' of the respondent was hypothesized to have a negative effect (−) on the grounds that older farmers are less likely to plant trees because they are less active and innovative than younger farmers. This approach provided a test of whether the initial hypothesis of the effect for each variable could be supported at a statistical significance level of 10% and 5%.

The 'Soil' and 'Forest' variables describe the general site characteristics with regard to the status of the soils and remaining open access to forest resources at the village level. It was hypothesized that good soil condition would enhance timber tree planting activities, while if natural forest still remain in the area it would have a negative effect on farmers motivation to plant timber trees. 'Accessibility' refers to the distance from each farm to the nearest market where tree products could be sold. It was hypothesized that a greater distance would discourage farmers from planting timber trees.

Cultural variables tested in the analysis include:

(a) 'Migration', which identifies farmers who have migrated from other municipalities or regions. It was hypothesized that migrant farmers have less interest in trees because they are usually focused on subsistence farming;
(b) 'Education', which denotes farmers that have studied beyond elementary school. It was hypothesized that educated farmers will be more open to tree planting;
(c) 'Age' of the respondent, which was hypothesized as having a negative effect because younger farmers seem to be more active;
(d) 'Tree experience', referring to the number of years that respondents have been engaged in any kind of timber tree planting activities. There is no correlation between this variable and the response variable because the response variable only applies for farmers who have planted native timber trees; a farmer could have long experience of tree planting (i.e. fruit tress) and be considered as a non-planter for the study. A positive effect was hypothesized on the assumption that farmers with more experience on any kind of tree planting activities will be more capable and knowledgeable about planting native timber trees.

Household land resources were included in the model through:

(a) 'Total area', to denote the total number of hectares that are managed by the household (including area owned and used as tenant). It was hypothesized that

the larger the area managed, the easier it would be to devote a portion to timber trees;

(b) 'Parcels', which refers to the number of parcels in the total area managed by households. It was hypothesized that with a larger number of parcels it would be easier farmers to plant timber trees because they can separate the various land uses;

(c) 'Area owned', indicating the proportion of area owned of the total area managed by households. It was hypothesized that farmers with a larger area owned would have more freedom and right to decide whether they want to plant trees.

Because tree cultivation is not as labour-demanding as annual cropping, it was also hypothesized that timber planting is likely to be a viable option for labour-constrained households and more attractive than other land-use alternatives including grass and bush fallows. Demographic variables selected are:

(a) 'Work intensity', representing the ratio between the numbers of working household members on-farm and the total area they manage. It was hypothesized that if the average area that each member has to manage is small enough they will tend to intensify agricultural land use instead of planting timber trees;

(b) 'Labour', representing the ratio between number of the on-farm working members to and total number of members. A small ratio means some labour constraints exist and therefore timber tree planting seems to be an attractive land-use alternative.

The last three variables explain household economic status.

(a) 'Income' is the ratio between the total household income (farm and off-farm income) and the number of working household members; it was hypothesized that if the household strategy is to maximize short-term profitability with existing labour resources, they will tend to not plant timber trees.

(b) 'Farm Income' is the ratio between yearly farm income and total household income (including remittances and income from off-farm work). It was hypothesized that the higher the proportion of income derived from farming, the lower the likelihood of tree planting because the farmer will tend to focus on agricultural crops.

(c) 'Productivity' is the relation between the farm income and total farm area managed. It was hypothesized that if the household strategy is to maximize profitability given their existing land resources they will tend to intensify their agricultural system and not plant timber trees.

Test of independence between explanatory variables

Once all variables from the model were defined and categorized, major patterns and relationships between the large numbers of independent variables were first examined by performing a scattered plot matrix analysis which shows the

relationship for each possible pair of variables. No strong correlations were found among the variables used, satisfying the assumption of independence in the final model set.

Social model analysis

Data were analysed using logistic regression tools with the econometric statistical software package STATA 9.1. The outcome is measured with a dichotomous variable, i.e. a binary variable which can only take values of zero or one, here 0 (non-planters) and 1 (planters).

Logistic regression generates the coefficients (and standard errors and significance levels) of a formula to predict a logit transformation of the probability of presence of the characteristic of interest. The hypothesized model for tree planting is:

$$\begin{aligned} &Log\,[(P(adoption=1))/(1-P\,(adoption=1))] = \beta_0 + \beta_1\,SOIL \\ &\quad +\beta_2\,FOREST + \beta_3\,ACCESS + \beta_4\,MIGRATION + \beta_5\,EDUCATION \\ &\quad +\beta_6\,AGE + \beta_7\,EXPERIENCE + \beta_8\,AREA + \beta_9\,PARCELS + \beta_{10}\,PROPERTY \\ &\quad +\beta_{11}\,WORK + \beta_{12}\,LABOUR + \beta_{13}\,INCOME + \beta_{14}\,FARM - INCOME \\ &\quad +\beta_{15}\,PRODUCTIVITY + \varepsilon_i \end{aligned}$$

where P is the probability of presence of the characteristic of interest. Rather than choosing parameters that minimize the sum of squared errors (as in ordinary least squares regression), estimation in logistic regression identifies parameters that maximize the likelihood of observing the sample values.

Logistic regression results include the change in the probabilities when the independent variable varies from its minimum to its maximum. The second column (dy/dx) shows the change when the independent variable varies for 0 to 1. This is most useful when analysing categorical variables. The third and fourth columns show the change in probabilities when the independent variable varies one unit in real value and in standard deviations respectively. The last column presents the marginal changes of the independent variable. All these values were calculated at the predicted probability when the independent variables equal their respective mean values.

After comparing and interpreting the results, few independent variables were selected as influencing farmers to plant timber trees at P-value of less than 0.1 (10% significance level).

Results

Logistic regression results from the household analysis are presented in Table 4. The model results suggest that timber trees planters are only influenced by two main groups of factors:

1. Availability of land resources in terms of total area, number of parcels and ownership; and

Table 4 Logistic regression results from the social model explaining main factors influencing smallholder farmers′ intention to plant native timber trees

Variable	Change probabilities dy/dx	Standard error	Change probabilities Z	Standard deviation $P > \|z\|$	Range (95% c.i.)		Marginal change (X)
Soil	0.1516	0.1011	1.50	0.134	−0.0466	0.3499	0.5633
Forest*	−0.1995	0.1141	−1.75	*0.080	−0.4233	0.0242	0.4577
Accessibility	0.0189	0.0122	1.55	0.122	−0.0050	0.0428	9.8450
Migration	−0.1056	0.1051	−1.00	0.315	−0.1702	0.1004	0.2042
Education	0.0552	0.1150	0.48	0.631	−0.0057	0.2807	0.2605
Age	0.0024	0.0041	0.58	0.559	−0.0090	0.0105	53.210
Experience	−0.0015	0.0038	−0.40	0.690	−0.0064	0.0059	16.470
Total area*	0.0395	0.0234	1.68	*0.092	−0.3157	0.0856	3.8200
Parcels**	−0.1696	0.0745	−2.28	**0.023	0.0052	−0.0234	1.2960
Area Owned**	0.2352	0.1173	2.00	**0.045	−0.1023	0.4651	0.6600
Work	0.0103	0.0574	0.18	0.858	−0.2466	0.1229	0.8689
Labour	0.2167	0.2364	0.92	0.359	−0.0000	0.6802	0.3848
Income	−0.0001	0.0000	−1.44	0.149	−0.3860	0.0001	12670.7
Farm income	−0.0565	0.1684	−0.34	0.737	−0.3860	0.2735	0.7499
Productivity	0.0000	0.0001	0.01	0.991	−0.0000	0.0001	6718.0

* and ** indicate statistical significance at 10 and 5% level respectively

(Number of observations = 148; Prob > chi^2 = 0.0757; LR chi^2 (15) = 23.41; Log likelihood = −83.940; Pseudo R^2 = 0.1224; Marginal effects after logit y = 0.3816)

2. Site characteristics in terms of accessibility to forest resources in the surrounding area.

All variables included in the model describing household land resources were found to be statistically significant and with coefficients having the expected signs. The positive values from the odds ratio coefficient of ‘Total area’ managed and proportion of ‘Area owned’ indicate relationships between these variables and the intention to plant timber trees. The negative sign from the ‘Parcels’ variable implies that the larger the number of parcels in which the total area is divided the lower the odds that the farmer will devote land to tree planting.

From the site characteristic level, the only significant variable is ‘Forest’, representing the accessibility to remaining forest resources in the area. The negative sign for the ‘Forest’ coefficient implies that the likelihood of adoption decreases with the existence of forests in the area. This can be easily interpreted as farmers living close to natural forest do not feel the necessity to plant timber trees on farmland because they can illegally collect their necessary tree products from the forest.

The coefficients for relationships between tree planting and other variables representing demographic, cultural and economic factors included in the model were not statistically significant. The influence of variables ‘Soil’ and total

household ‘Income’ is unclear from the results. Although their coefficience signs are in the direction hypothesized, the variability on the data does not rule out the null hypothesis of no relationship. The analysis suggests that tree adoption may be negatively related to total household ‘Income’ (including from on-farm and off-farm sources), such that if the household financial situation improves (usually from off-farm sources) they will progressively abandon on-farm activities, which eventually might be the ultimate goal of many farmers for their future generations.

The relationship between availability of family labour resources—‘Work’ and ‘Labour’—and tree adoption was not captured in the model. There is, however, suggestive evidence of an interactive effect between these variables and the intention to plant native timber trees reflected in the positive sign of their odd ratio coefficient dy/dx (Table 4). Contrary to expectations, variation in ‘Farm income’, land ‘Productivity’ and farmers’ tree planting experience (‘Experience’) does not appear to be associated with the adoption of native timber trees.

Discussion

In general, the study results suggest two main ideas: (a) an agroforestation phase in the Philippines has little chance of increasing tree cover while ever de facto access to native forests still provides timber resources below economic replacement cost; and (b) the level of land resources controlled by the household—in terms of the total area and number of parcels managed—and land ownership security stand out as the main factors that affect farmers’ decisions to plant native timber trees. A direct conclusion from these results is that targeting reforestation programs to areas that are already highly deforested (or have high potential for degradation) together with areas with secure land tenure should have the greatest chance of success.

In the Philippines complicated government regulations and permit requirements are imposed on the harvest and use of farm-grown trees, particularly native tree species (Van Noordwijk et al. 2008). However, in the study area this limitation over property rights does not seem to prevent tree planting, because the study results showed that land ownership and the level of land resources controlled by households (in terms of the total area and number of parcels), are the main factors influencing timber tree planting.

Lack of government control over public land may mean that initial occupation is relatively easy and inexpensive, and thus land resources encourage further extensive conversion of forest land to agriculture. Past government policy changes have provided non-owners who cultivate public land with the opportunity to obtain a Certificate of Stewardship Contract on this land, which may ultimately grant them the right to own the land (Pascicolan et al. 1997). This institutional and policy environment provided the appropriate initial conditions to promote sustainable land-use systems in the Philippines.

A key aspect of the location is the remoteness, as measured by the distance to city markets and road access. Road building and insecure property rights in frontier forest areas artificially depress the land price and make land readily available to farmers. This study showed that access to markets have a positive influence on tree

planting activities, suggesting that improvements of rural infrastructure including roads encourage more intensive production of agricultural and tree crops.

Because smallholder tree planting is not just a production strategy for maximizing profit but a strategy to respond to farmers' changing resources and circumstances (Arnold and Dewees 1995), is understandable that *labour* and *capital* factors were not found to have a significant influence on tree adoption. In situations where capital and labour are scarce, trees can be planted as a low-input, low-management crop to make more productive use of land (Bertomeu 2006). Trees can also maximize returns to land when crop productivity declines to below economic levels. Lastly, trees can contribute to risk management through diversification of outputs, avoiding labour bottlenecks and spreading risks (Arnold and Dewees 1995). Therefore, the major advantage of a wide repertoire of tree production strategies is its flexibility to match farmers' individual needs and preferences within their specific conditions and changing circumstances (Cramb 2000).

Contrary to expectations, 'cultural' and 'demographic' aspects of household communities were found to have little differentiating effect on farmers′ tree planting decisions, once farm size and landscape position is accounted for. These findings are also in line with FMB-FAO (2003) where it was found that in West Africa no direct correlations existebetween tree planters and diverse ethnic groups (Kojo 2003).

Rudel et al. (2005) suggested two possible pathways for advancing forest transition. One is the 'economic development route', where the farming population declines as industrialisation and urban migration proceed, and abandoned agricultural land is spontaneously reforested. The other is the 'forest scarcity pathway', where scarcity of forest products drives up their price and stimulates tree planting. Rudel et al. (2005) emphasized that overlaps can occur between these two types, but the implication is that different causes apply to these pathways. One could be labelled as industrialisation, economic development or modernisation, while the other has a more directly economic cause in terms of a market response to trends in demand and supply of forest products. The latter may be combined with 'economic transformation' (Tomich et al. 1995; van Noordwijk et al. 1995) where industrial, urban type jobs take over from agriculture as the primary source of employment and land/labour ratios decrease, causing for reduced 'returns to land' but increased 'returns to labour'.

In the Philippines, as industrialization and economic development proceed, the key forestry questions now are whether the forest transition will continue despite of existing barriers to native timber tree planting (Van Noordwijk et al. 2008), and whether agroforestry land uses can facilitate the economic transformation that is taking place in rural areas of the Philippines (MEA 2005).

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